

Applications using Satellite Sounder Products at the NASA SPoRT Center

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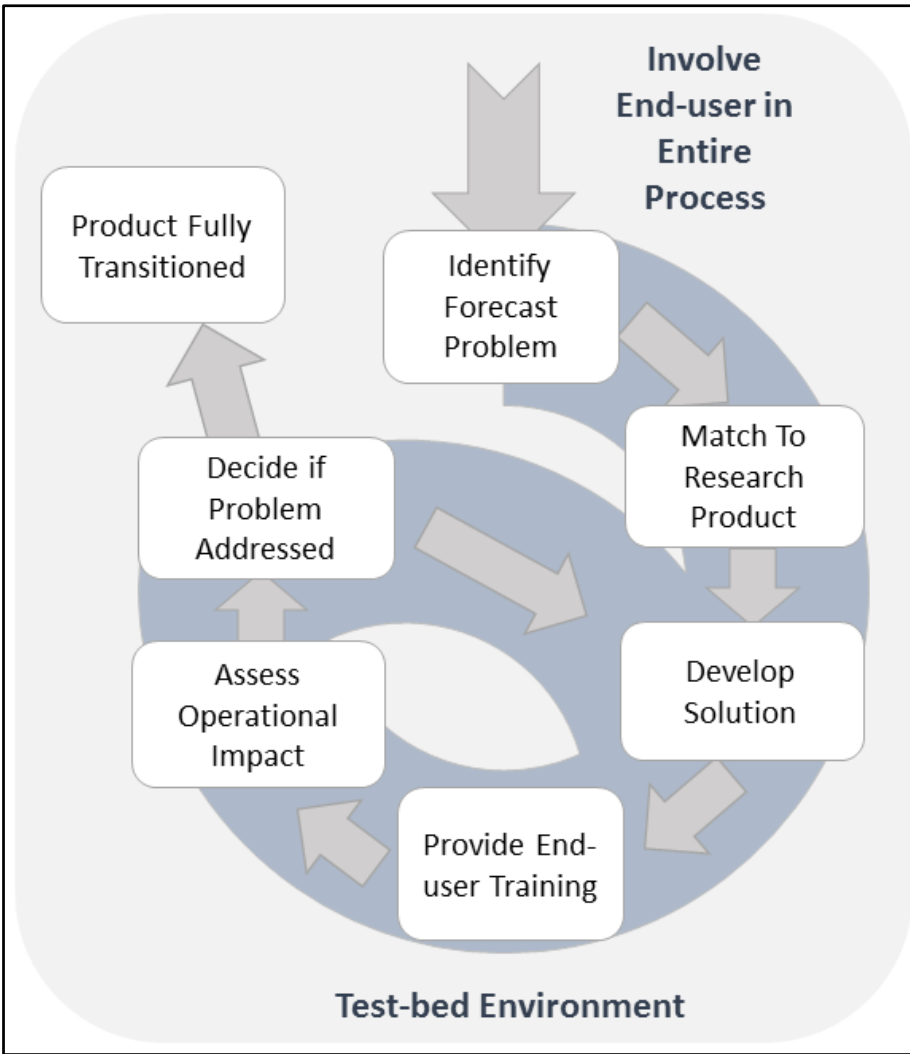
AIRS Science Team Meeting
22 March 2016



transitioning unique NASA data and research technologies to operations



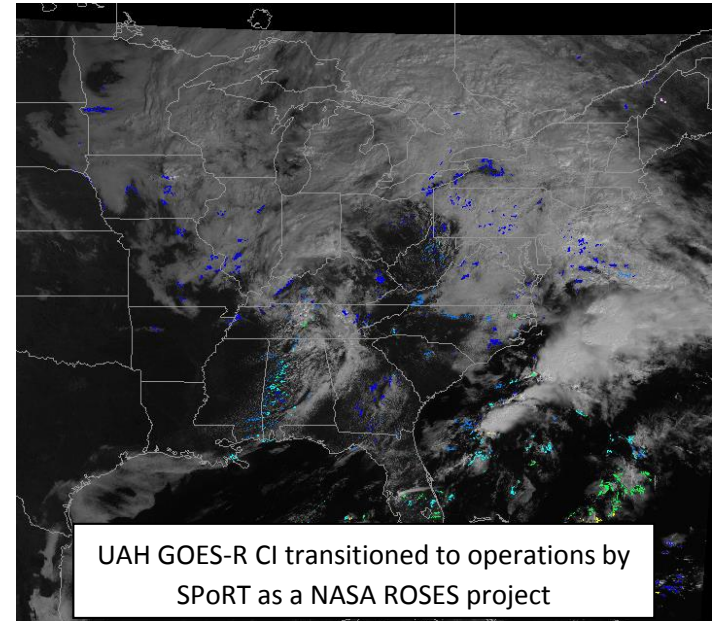
SPoRT Mission and Paradigm



- *Apply satellite measurement systems and unique Earth science research to improve the accuracy of short-term weather prediction at the regional and local scale*
- Bridge the “Valley of Death”
- Can’t just “throw data over the fence”
 - Maintain interactive partnerships with help of specific advocates or “satellite champions”
 - Integrate into user decision support tools
 - Create forecaster training on product utility
 - Perform targeted product assessments with close collaborating partners
- Concept has been used to successfully transition a variety of satellite datasets to operational users for nearly 10 years

Transitioning Data to Operations

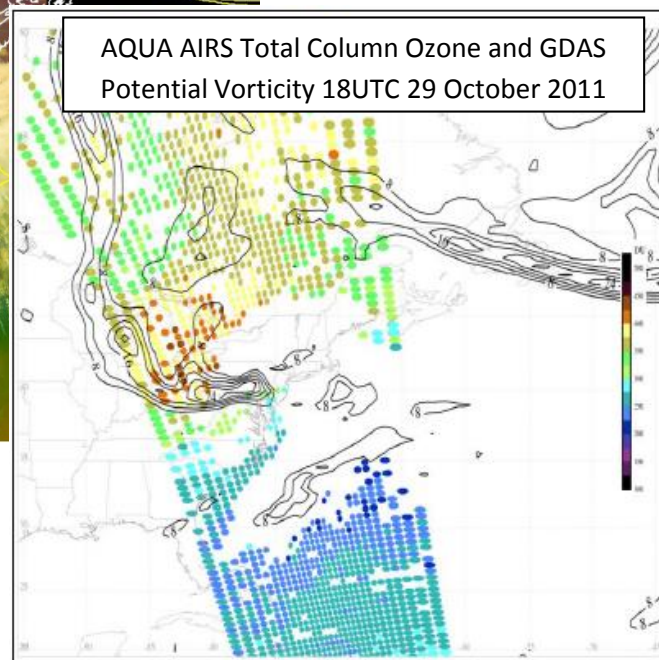
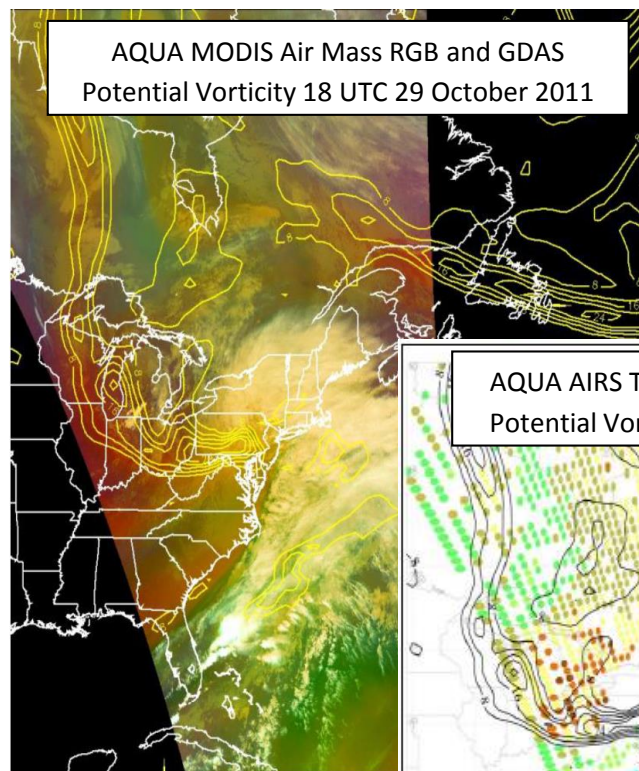
- SPoRT has a history of facilitating the transition of products to operations
 - Collaborate with more than 30 NWS Forecast Offices and National Centers across all six NWS regions
 - Examples include GOES-R Convective Initiation, CIRA Layered Precipitable Water, NESDIS Snowfall rate



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 - Examples include GOES-R Convective Initiation, CIRA Layered Precipitable Water, NESDIS Snowfall rate
- NASA ROSES 2016 A.29 NASA Data for Operation and Assessment
 - SPoRT will work with funded projects to:
 - Integrate product into AWIPS-II or another decision support system
 - Develop appropriate training modules
 - Assess the impact of the transitioned product on weather forecast operations

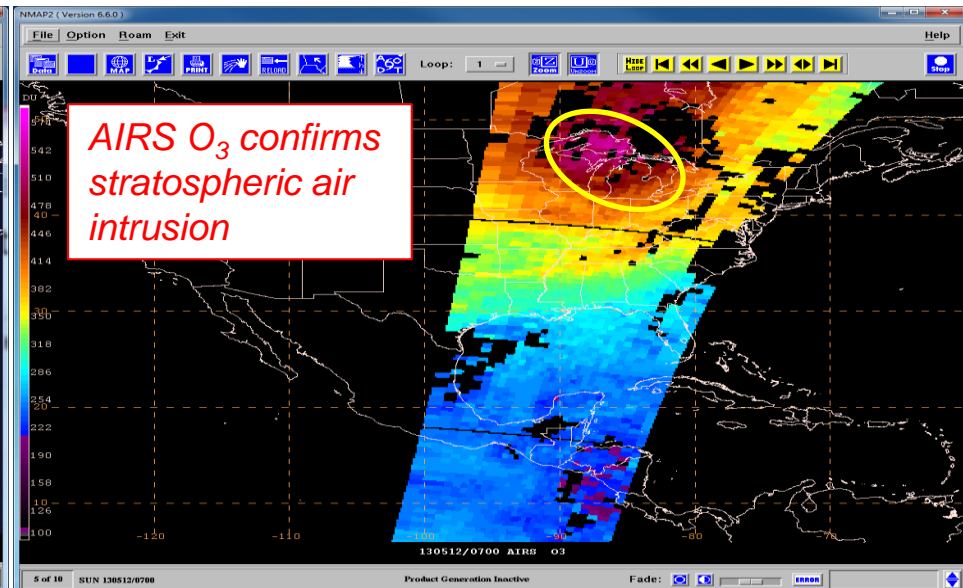
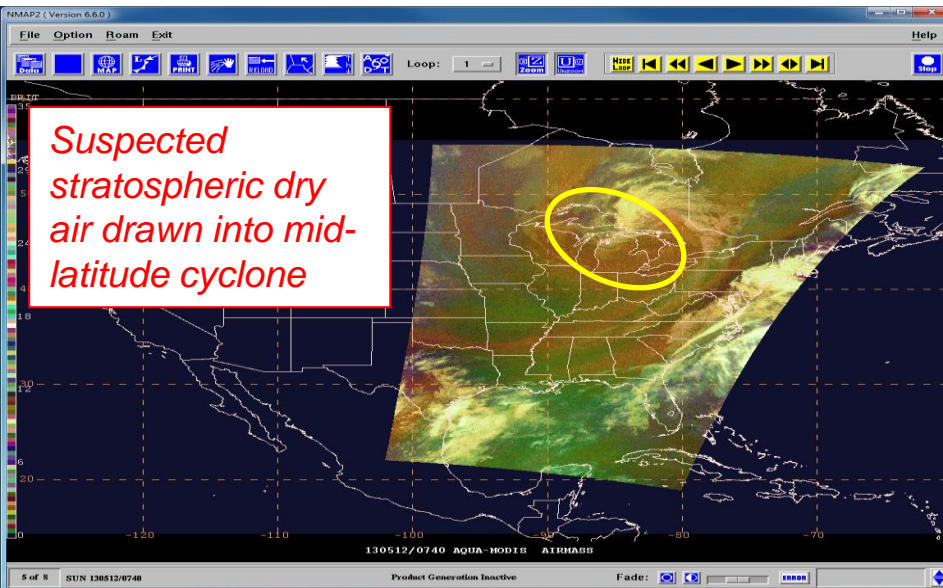
SPoRT Ozone Products

- In 2011/2012 SPoRT worked with the GOES-R Proving Ground to explore use of NASA ozone retrievals as a stratospheric air tracer
 - Aid interpretation of the Air Mass RGB
 - Assist National Centers forecasters with forecasting rapid cyclogenesis
- AIRS Version 5 Level 2 ozone retrievals were put in N-AWIPS format for National Centers
- AIRS Ozone product was used experimentally in operations



B. T. Zavodsky, A. L. Molthan, and M. J. Folmer, "Multispectral imagery for detecting stratospheric air intrusions associated with mid-latitude cyclones," J. Operational Meteor., vol. 1, no. 7, pp. 71-83, Jul. 2013.

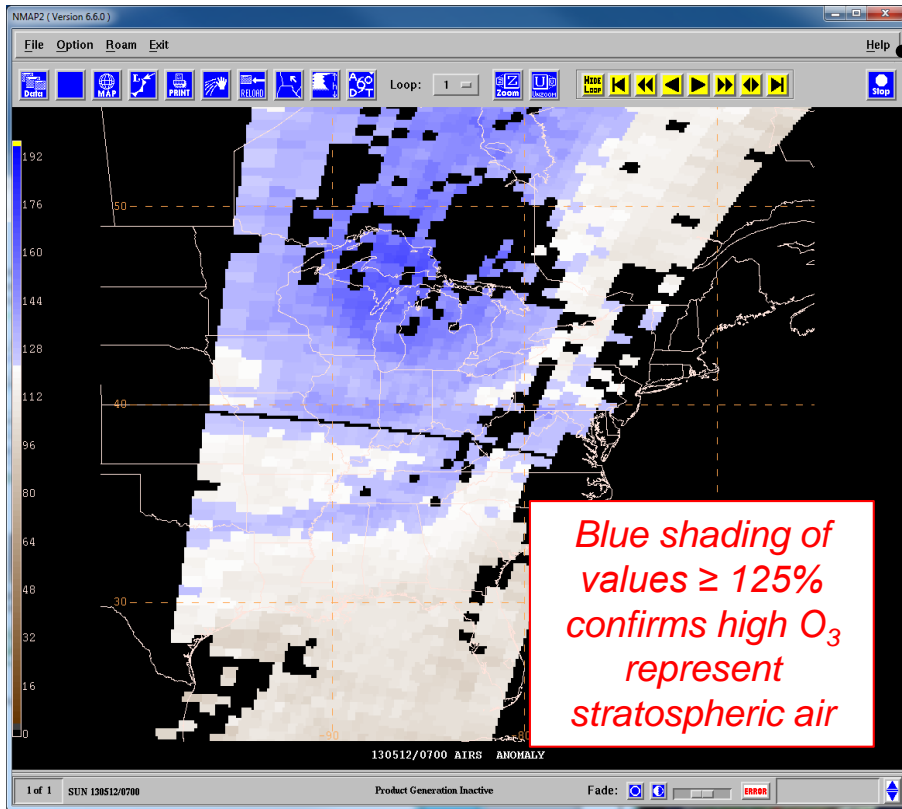
SPoRT Ozone Products



- Identification of stratospheric intrusions associated with mid-latitude and extratropical cyclone strengthening and damaging non-convective winds
- Enhances interpretation of RGB products
- Full transition of product to National Centers (WPC and OPC) in N-AWIPS
- Numerous posts on SPoRT and NOAA Proving Ground blogs related to product
- Anomaly product developed to confirm high ozone values are stratospheric and not just within the climatological range

Ozone Anomaly Product

- Identification of stratospheric air based on high ozone values could lead to misinterpretation if the values actually range within climatology since the mean varies seasonally and spatially

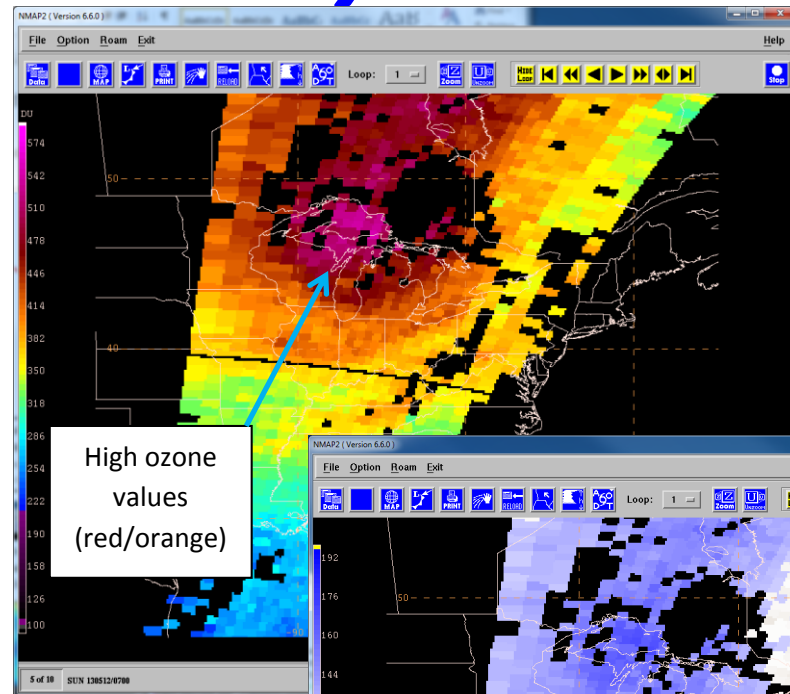
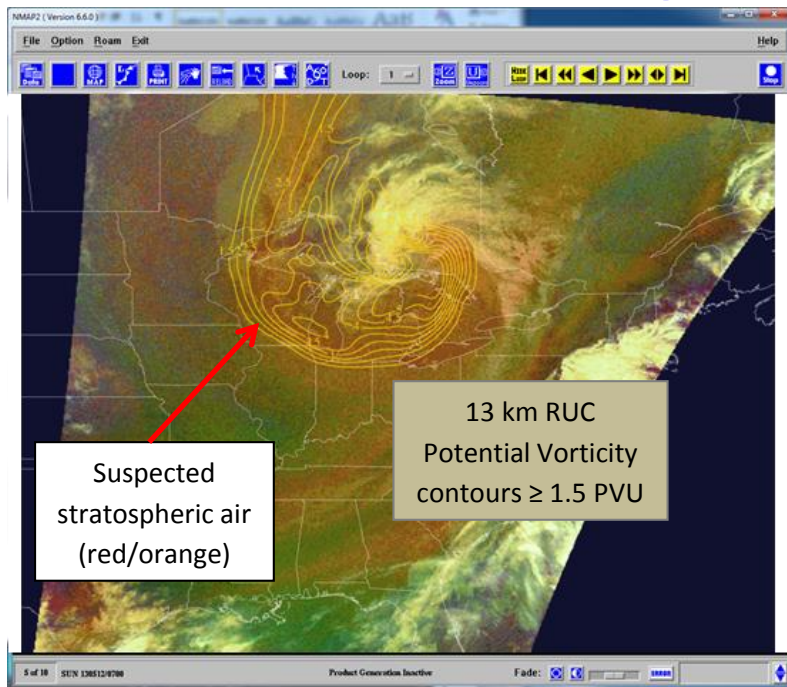


The AIRS Ozone Anomaly product clarifies the presence of stratospheric air based on:

- Stratospheric air has ozone values at least 25% larger than the climatological mean (Van Haver et al. 1996)
- Global and zonal monthly mean climatology of stratospheric ozone derived from the NASA Microwave Limb Sounder (Ziemke et al. 2011)

E. B. Berndt, B. T. Zavodsky and M. J. Folmer, "Development and Application of Atmospheric Infrared Sounder Ozone Retrieval Products for Operational Meteorology," IEEE Transactions on Geoscience and Remote Sensing, vol. 54, no. 2, pp. 958-967, Feb. 2016.

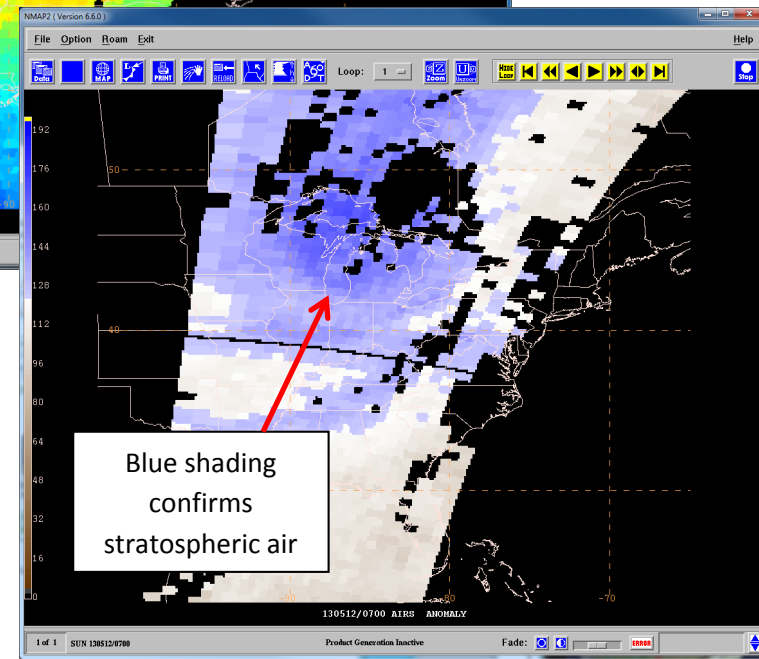
Example 12 May 2013



- SPoRT AIRS Ozone Anomaly product created as a percent of normal (0-200%)

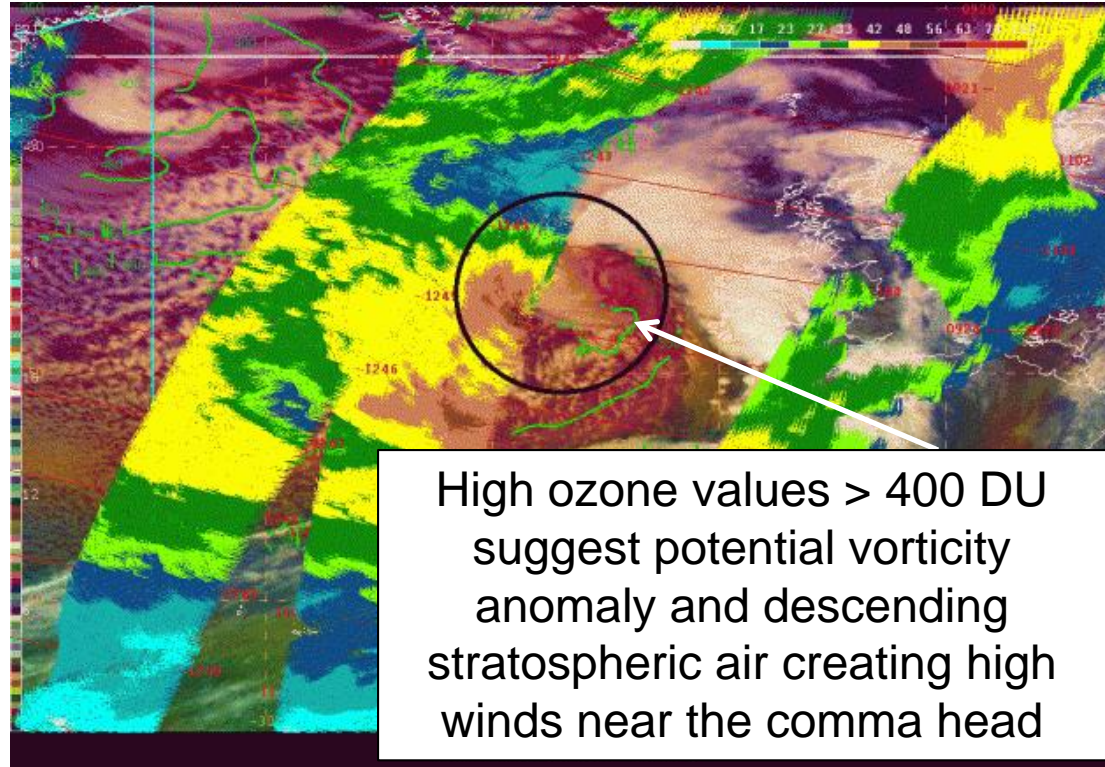
$$PON = \frac{TCO}{climo} \times 100$$

- Shades of blue represent stratospheric air (ozone values $\geq 125\%$)



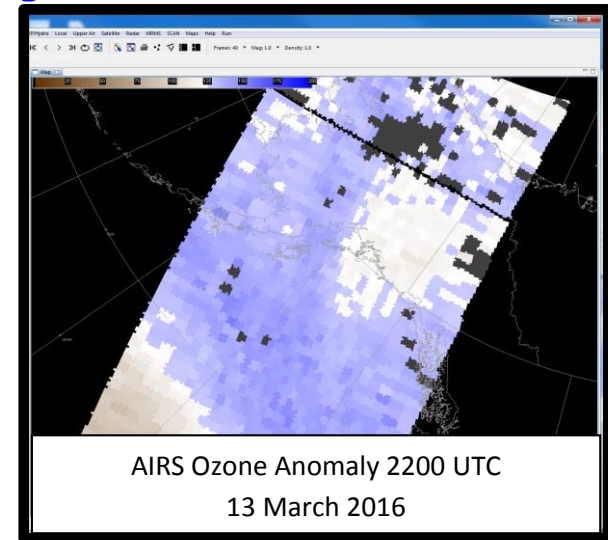
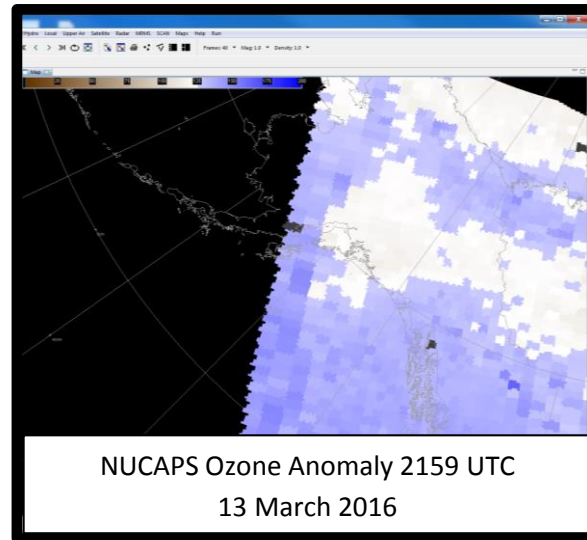
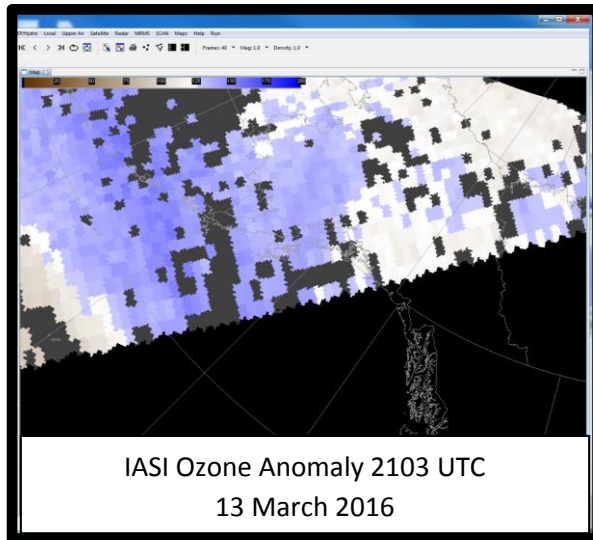
Demonstration at National Centers

- AIRS ozone products evaluated at OPC, WPC, SAB winter 2013-2014
- Image and gridded products were available for overlay
- Forecaster Feedback
 - “**Reinforce the evidence from RGB** of the descent of stratospheric air with tropopause folding.”
 - “This has allowed me to **have confidence in assessing the RGB Airmass product** and also in conjunction with gridded GFS output that a perceived PV anomaly is real or not.”



SEVIRI RGB Air Mass image, AIRS Total Column Ozone (green contours), and ASCAT winds valid at 1400 UTC on 12/18/13. The black circle highlights the descending stratospheric intrusion near the comma-head/bent back front. Image courtesy of Michael Folmer, Satellite Liaison at NOAA/NWS WPC/OPC/TAFB and NOAA/NESDIS SAB

New Product Development

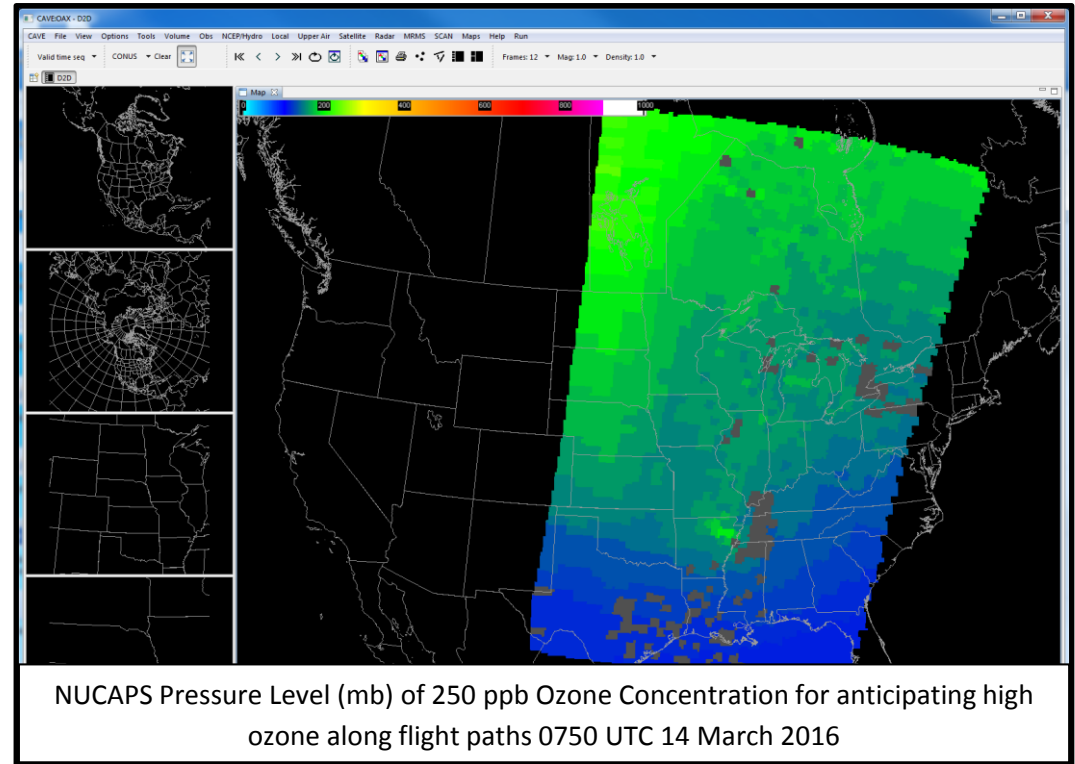


- Adjusted product according to forecaster feedback from the winter 2014 product demonstration at OPC
- Total column ozone and ozone anomaly available from AIRS, CrIS/ATMS, and IASI
- Additional overpasses for forecasters to evaluate
- Products now available in NAWIPS *and* AWIPS-II

“There may have been 1 occasion where 1 pass did line up over the US with the spot I was interested in. In that case, it was helpful in reaffirming my suspicions on whether stratospheric air was present. Otherwise, the passes were few and far between and not particularly timely. If there was greater coverage of passes and not as much of a lag, it would certainly be useful.”

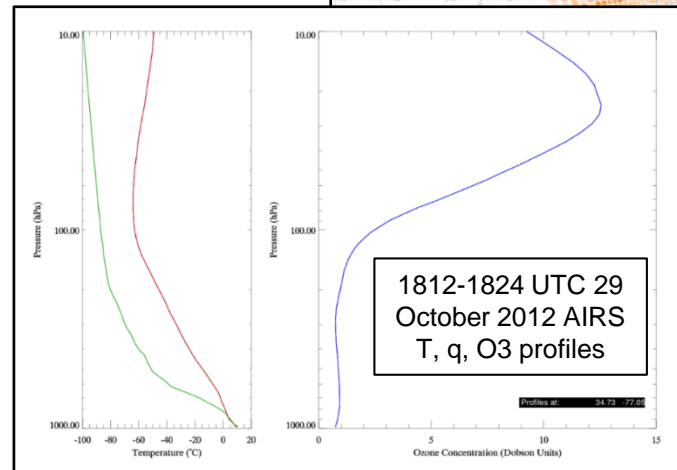
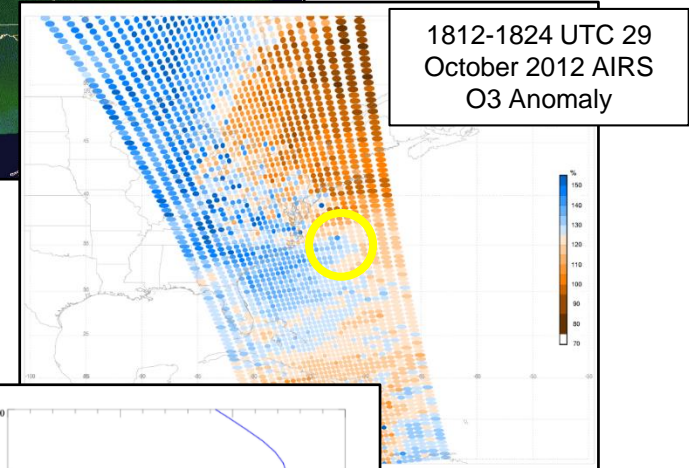
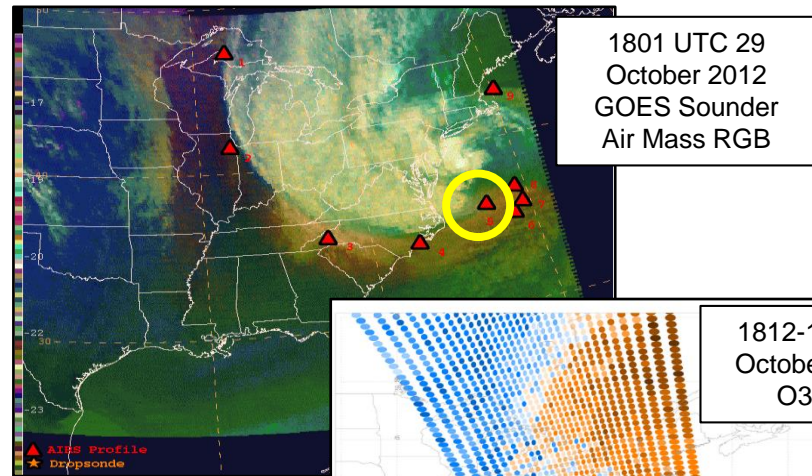
New Product Development

- Additional applications and product development continuing in 2016
- Aviation Weather Center
 - Compare ozone products to air mass RGB to anticipate turbulence near the jet stream
 - Monitor high ozone along flight path that could pose passenger and crew health concern
- JPSS funded project to investigate use of NUCAPS soundings for hurricane tropical to extratropical transition



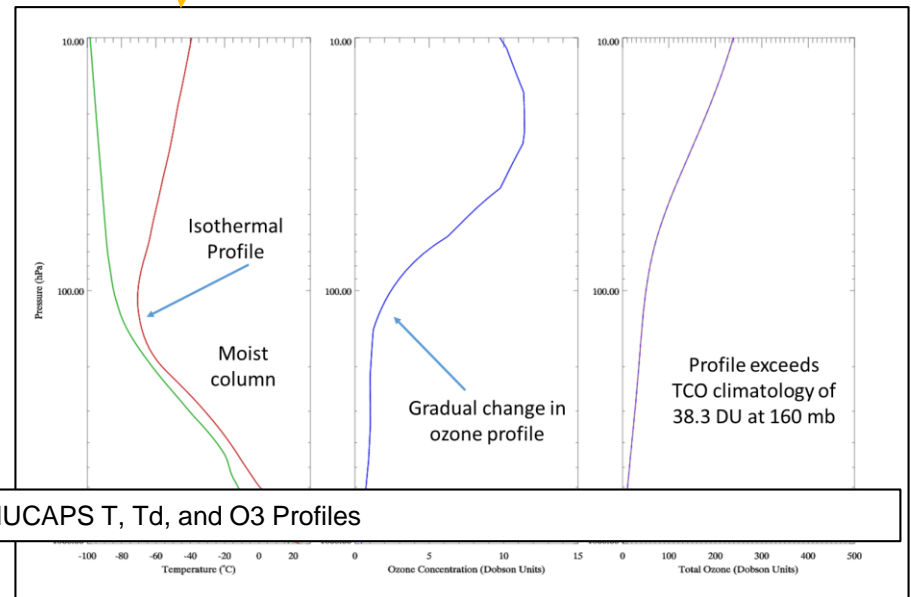
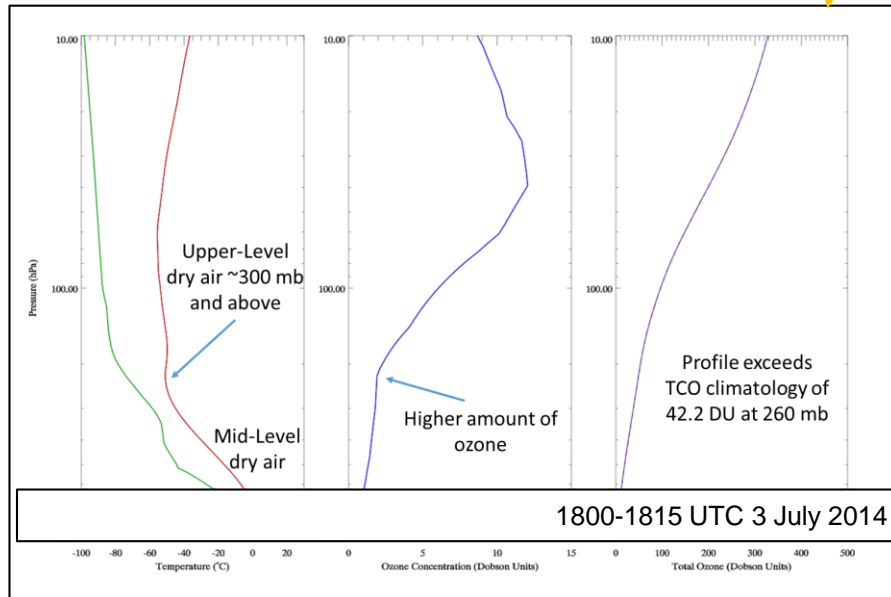
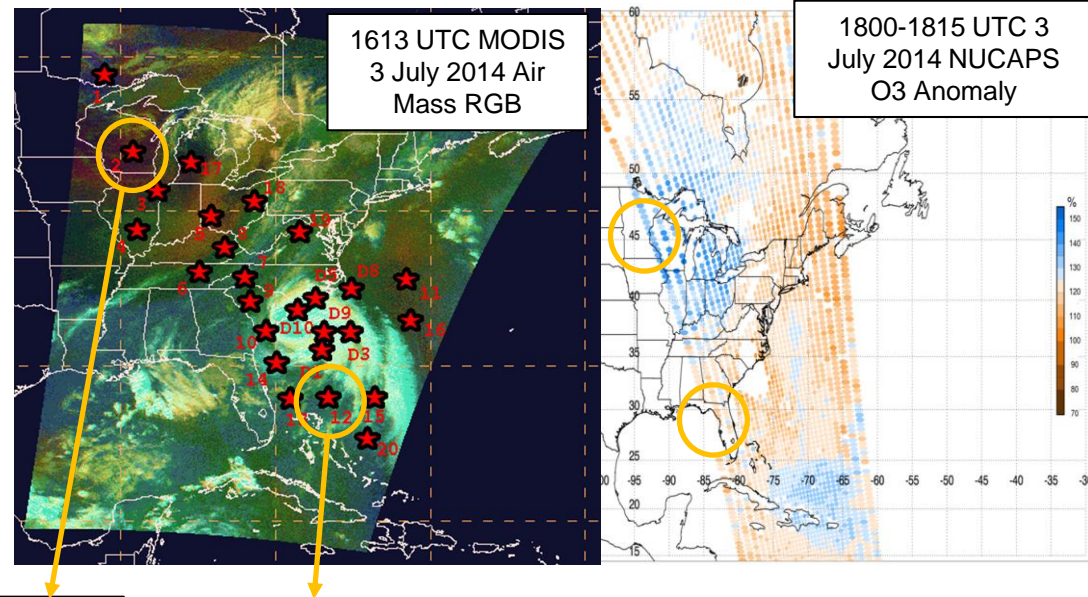
Hurricane Extratropical Transition

- National Centers' forecasters have GOES-R/JPSS Proving Ground proxy products, such as the Air Mass RGB, to assist in monitoring extratropical transition of hurricanes
- Air Mass RGB product provides an enhanced view of various air masses in one complete image to help differentiate between possible stratospheric/tropospheric interactions
- NUCAPS sounding can compliment the Air Mass RGB by providing insight about the vertical structure of the atmosphere
- Since NUCAPS soundings are already in AWIPS-II this projects investigates the utility of NUCAPS soundings for another unique forecasting challenge
- Preliminary work with Sandy 2012



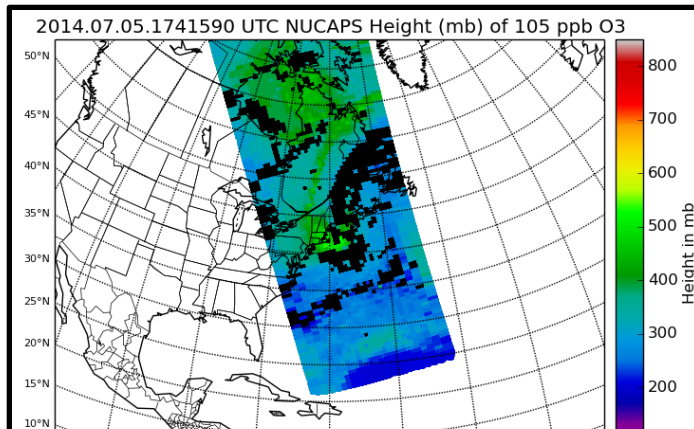
Hurricane Extratropical Transition

- Arthur 2014 investigated
- Profiles in red/orange regions confirm mid- and upper-level dry air and lower tropopause
- Profile near the storm in blue/green regions confirm a moist column, a gradual change in the ozone profile, and a higher tropopause

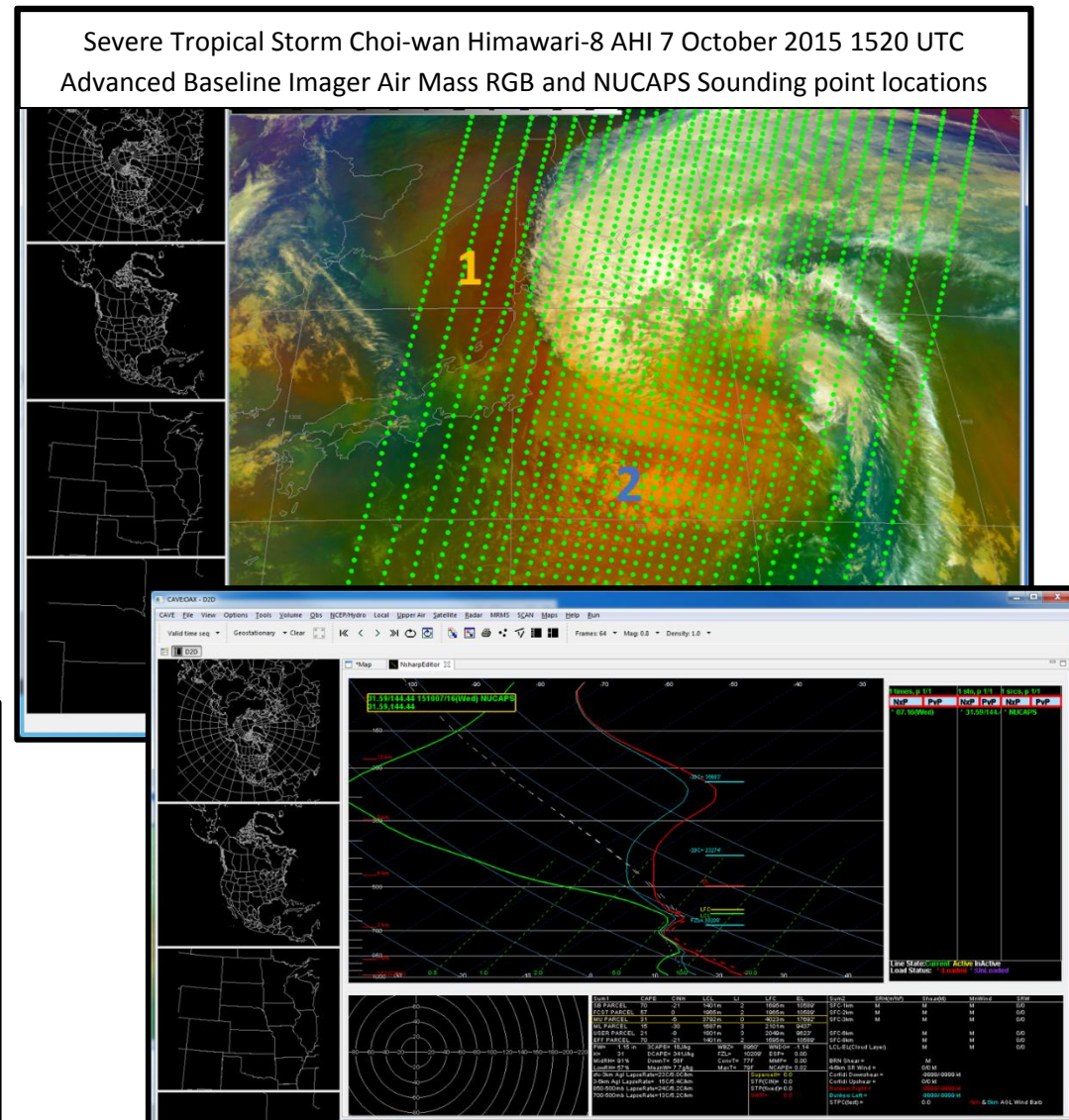


Hurricane Extratropical Transition

- Planned product demonstration with National Centers (NHC, OPC, WPC) during latter half of 2016 hurricane season
- Utility of NUCAPS
 - Point-based soundings in AWIPS-II
 - Stratospheric depth product
- Hope to gain forecaster feedback on product utility during complex extratropical transition events



Example stratospheric depth product to identify chemical and dynamic tropopause based on Thouret et al. 2006 product provide vertical information compared to the Air Mass RGB



NUCAPS Sounding point locations 7 October 2015 1500 UTC taken near point 2 in a region of upper-level dry air (orange coloring) and mid-level clouds (light orange coloring)

Summary

- SPoRT is a proven community leader for transitioning satellite products to operational end users and is working to bring data from hyperspectral infrared sounders to forecasters
- SPoRT has worked closely the GOES-R and JPSS Proving Ground to develop and transition ozone products to National Centers for forecasting rapid cyclogenesis and hurricane force wind events products
- Products are derived from AIRS, IASI, and CrIS/ATMS retrievals and are available in NAWIPS and AWIPS-II
- SPoRT is continuing to investigate the utility of NUCAPS profiles for other applications for aviation forecasting and hurricane tropical to extratropical transition

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<http://weather.msfc.nasa.gov/sport/>

<http://nasasport.wordpress.com/>



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References

- E. B. Berndt, B. T. Zavodsky and M. J. Folmer, "Development and Application of Atmospheric Infrared Sounder Ozone Retrieval Products for Operational Meteorology," IEEE Transactions on Geoscience and Remote Sensing, vol. 54, no. 2, pp. 958-967, Feb. 2016.
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